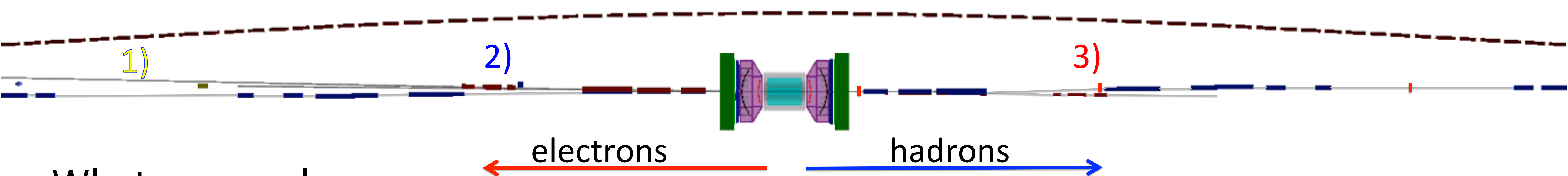


The evolution of RHIC to eRHIC: Interaction region design for an electron-ion collider at BNL

Richard Petti (BNL) for the BNL EIC Science Task Force

Abstract: With the RHIC program coming to an end, scientists are now turning their attention to the future of nuclear physics with detailed studies on the role of gluons in the proton and the nucleus. These studies can be ideally carried out at an electron-ion collider facility, where it is expected to definitely illuminate the role of the gluon to the spin of the proton and to observe the effects of gluon saturation in the nucleus at high energy. The physics requirements on key measurements guide the design of the accelerator and detectors. We focus on the design considerations and efforts of the interaction region (IR).



What we need:

- 1) Luminosity Monitor 2) Low Q^2 -tagger 3) Roman pots 4) Polarimetry

Luminosity monitor

- WHY: need percent level precision lumi measurement
- HOW: measure via well known $ep \rightarrow e\gamma$ process
- WHAT: central emcal for direct measurement and dipole spectrometer for secondary measurement
- WHERE: placed in electron outgoing beam direction after electron beam bends away

$$L = \frac{N_\gamma}{A\sigma}$$

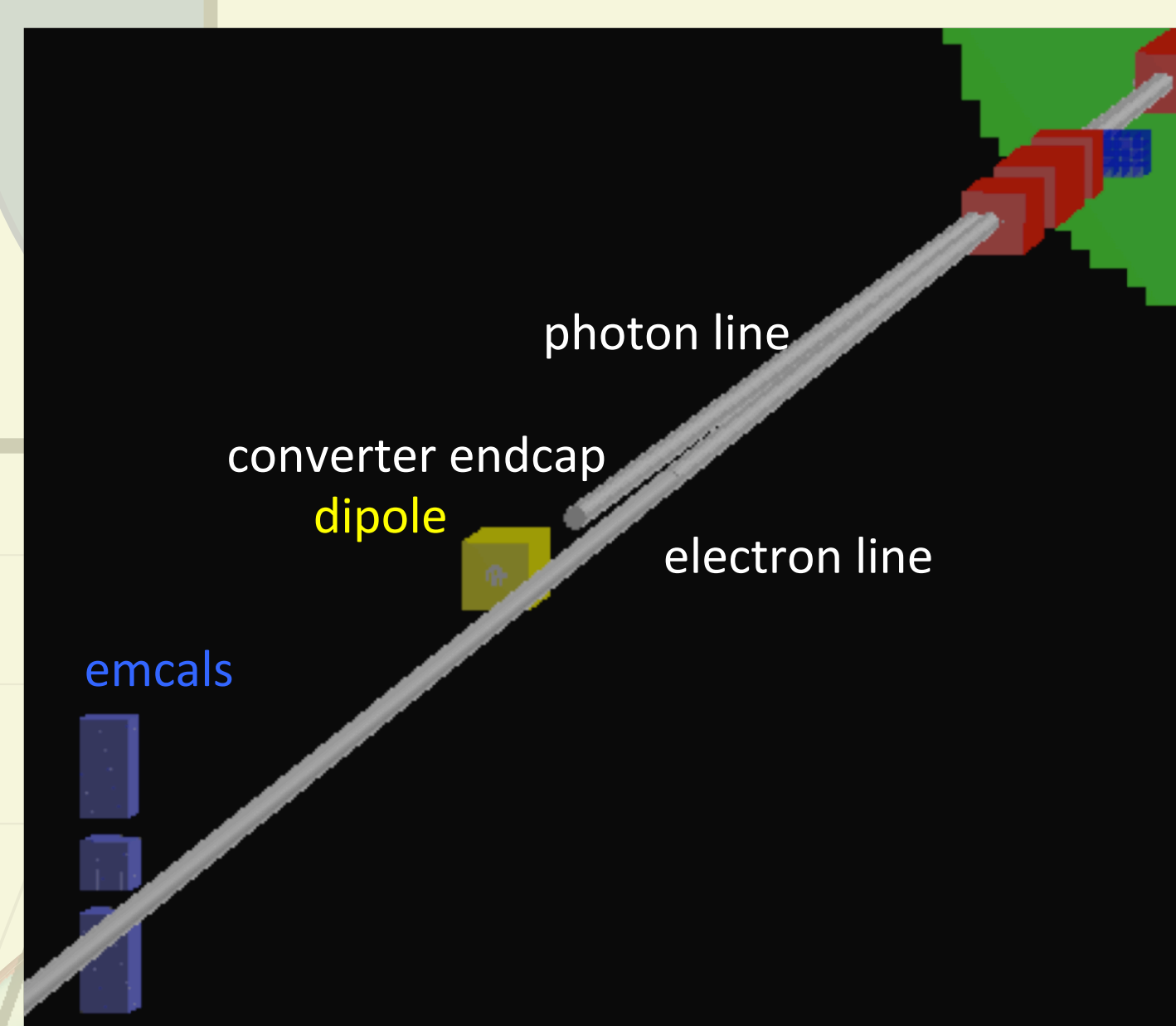


Fig: schematic layout of lumi monitor

Low Q^2 -tagger

- WHY: study the virtual photon structure
- HOW: detect scattered electrons that miss main detector ($Q^2 < 0.1 \text{ GeV}^2$)
- WHAT: compact detector with tracking layers and an emcal
- WHERE: positioned in outgoing electron beam direction after first bending dipole ($\sim -15\text{m}$)

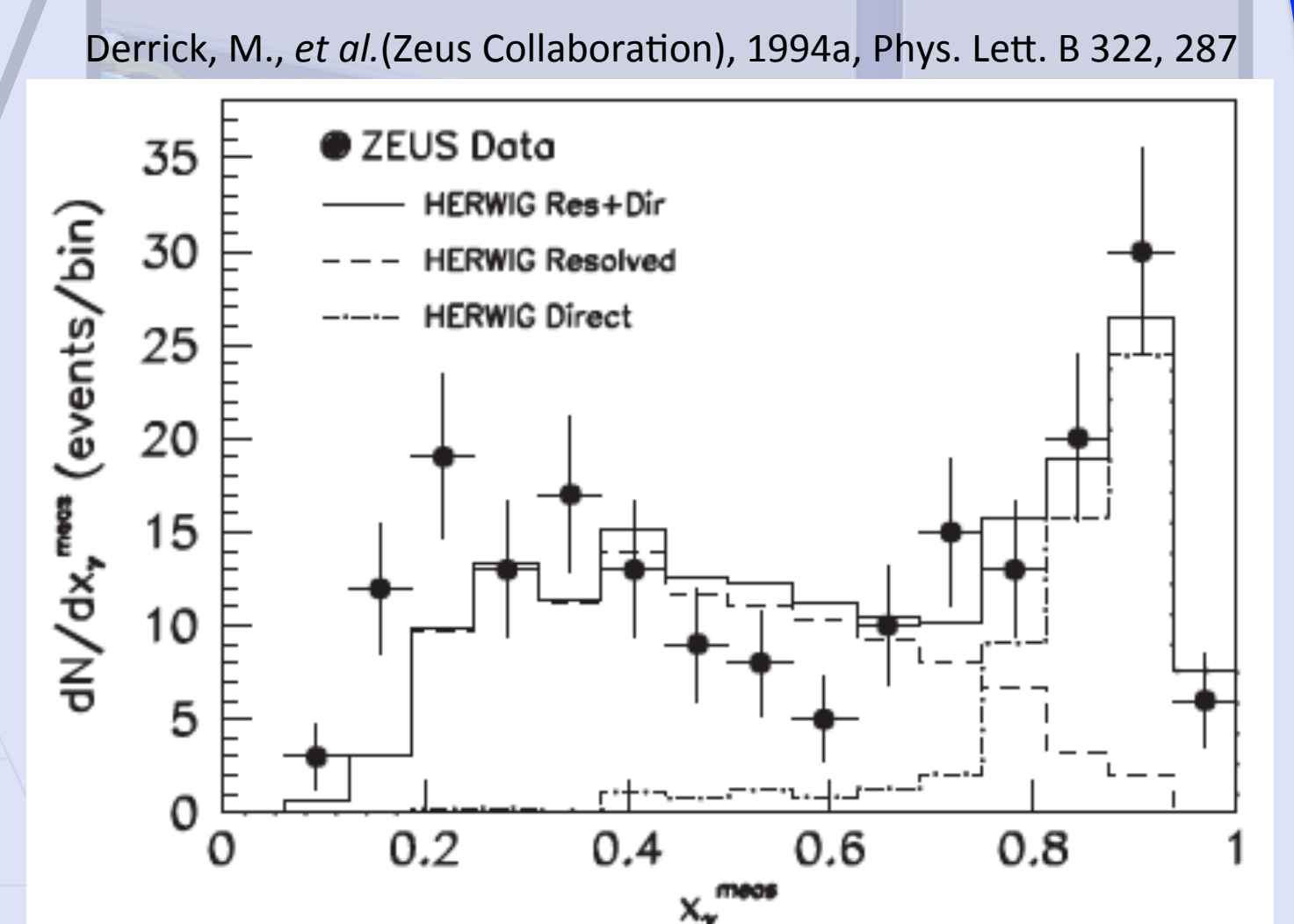
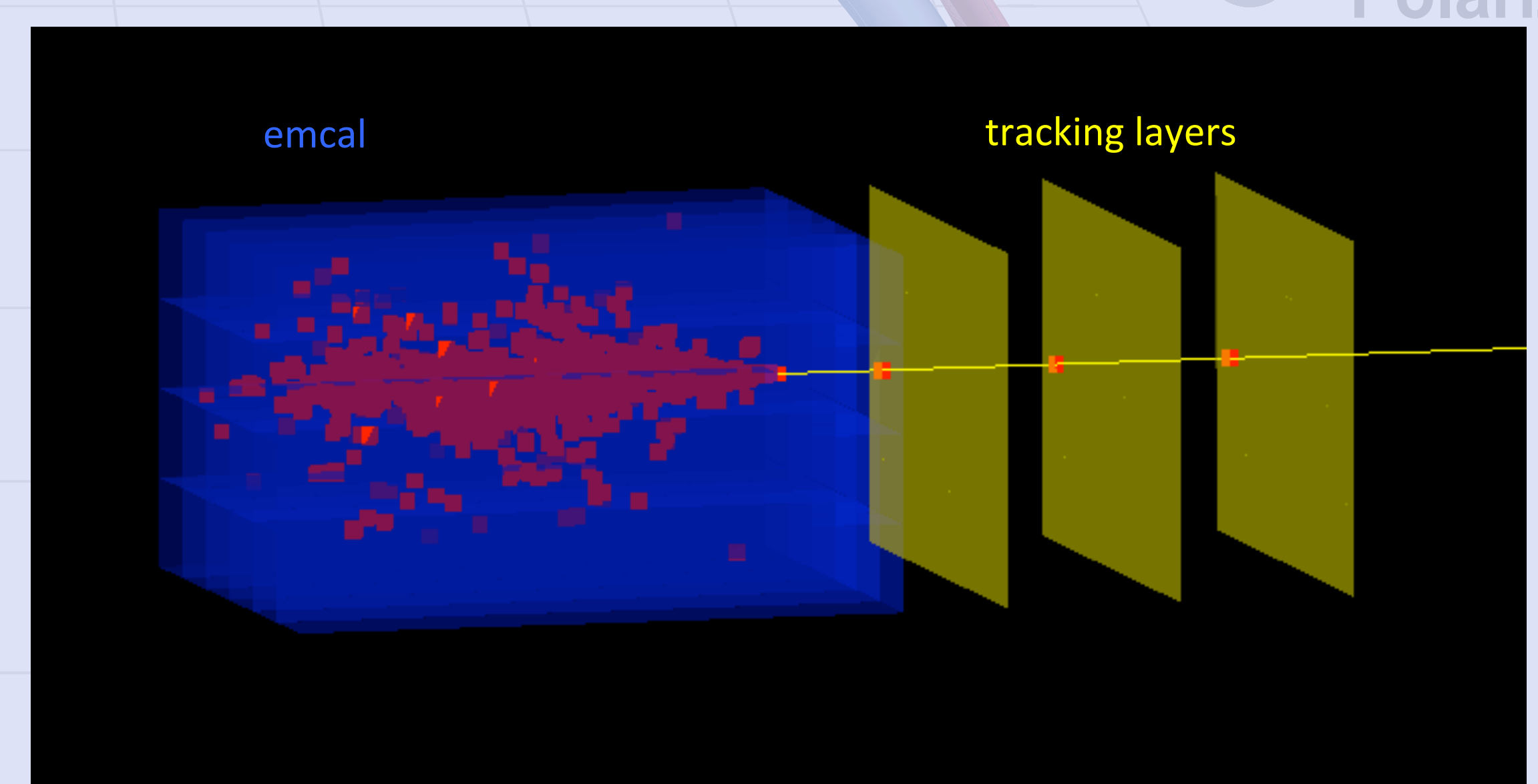


Fig: evidence of photon structure

$$x_{\gamma}^{meas} = \frac{\sum_{\text{jets}} (E - p_z)_{\text{jets}}}{\sum_i (E - p_z)_i}$$

Fig: geometry for the low Q^2 -tagger



Roman Pots

- WHY: measurement of GPDs in $e-p$ collisions
- HOW: study exclusive processes in DVCS and VM production
- key kinematic variable $t = (p' - p)^2$, so need to measure scattered proton at low scattering angle
- WHERE: multiple stations along outgoing proton beam at different locations

Fig: phase space for scattered protons in DVCS

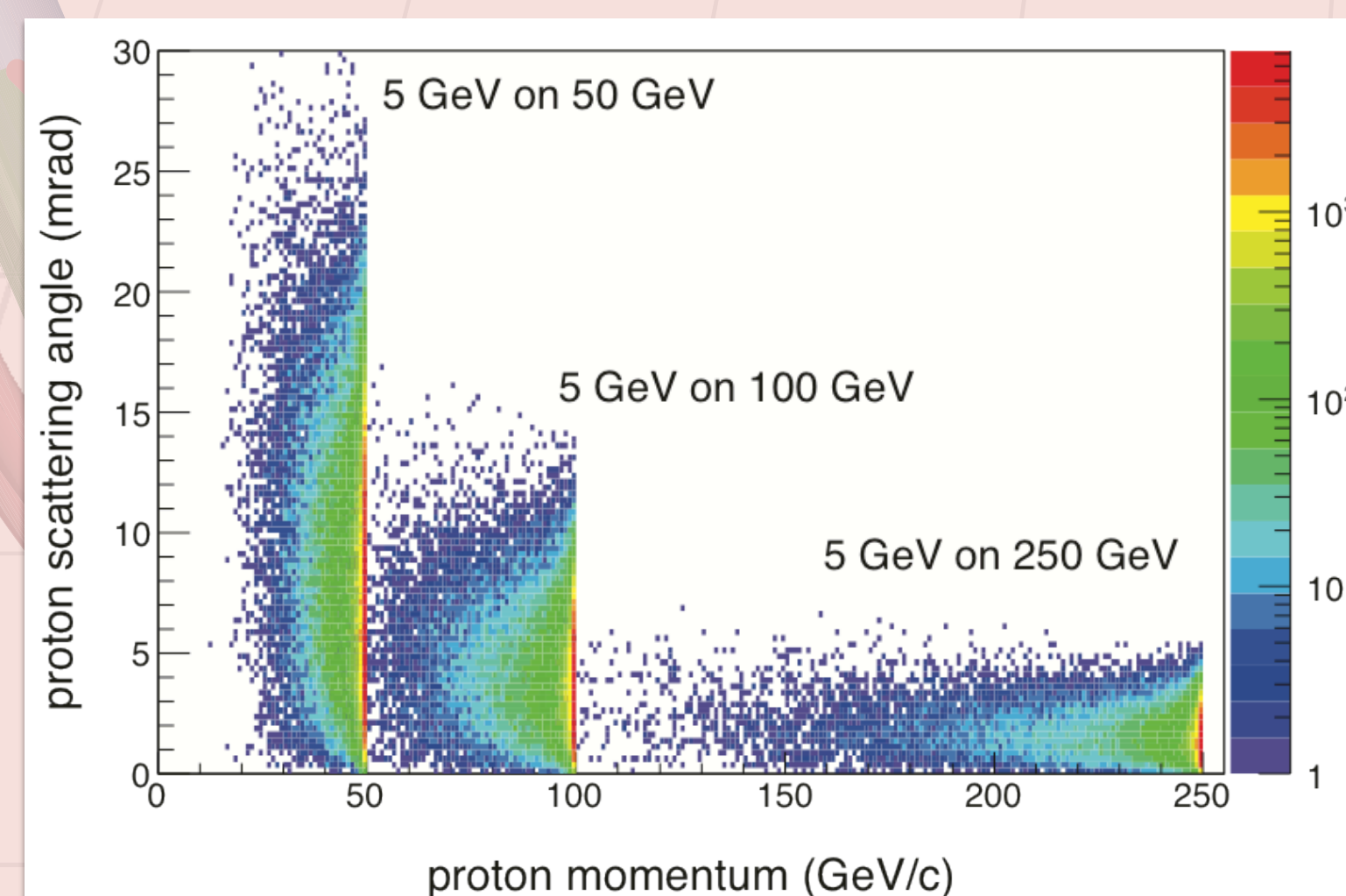
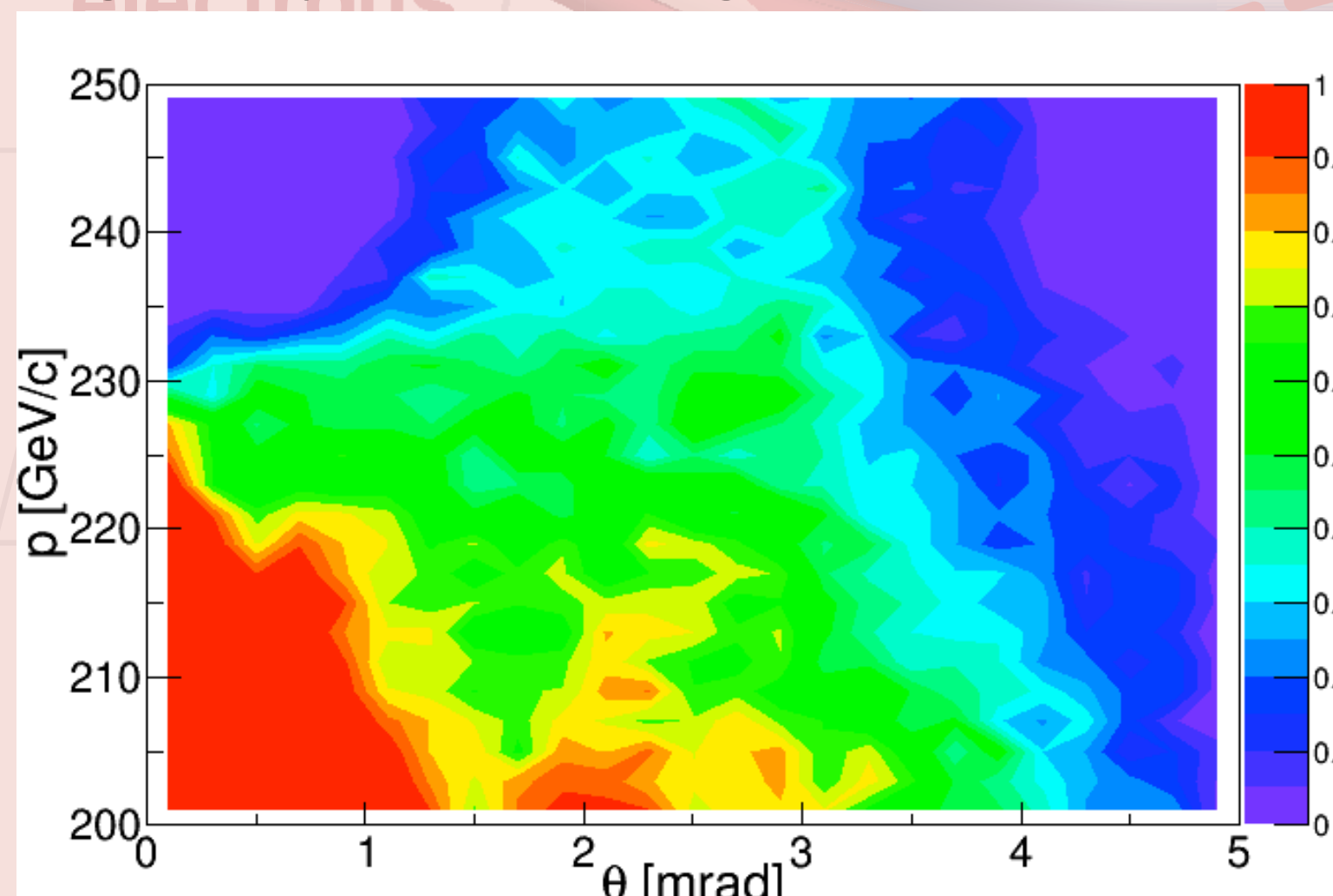


Fig: acceptance for single station at 18m



Polarimetry on electron beam

- WHY: precise knowledge of polarization of the beams is required to study any associated spin phenomena including constraining the gluon spin contribution to the proton
- HOW: Compton backscattering of photons

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